

# *The Role of Advanced Science in Mitigating the Biological Weapons, Public Health and Environmental Threats in Central Asia*

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- **Threats and Risks to Stability in Central Asia**
  - Proliferation of biological weapons material
  - State of environmental and animal health
  - State of human health
- **Role of Advanced Science in Mitigating these Threats and Risks**
  - Decontamination of Vozrozhdeniye Island
  - Cooperative environmental and animal health monitoring
  - Cooperative syndromic and epidemiological monitoring

# Biological Weapons Proliferation Threat



- **Intentional acquisition of pathogenic material from Vozrozhdeniye Island**
  - Suspected that, before discontinuing their operations, Soviets buried bleach-soaked anthrax and plague on the island
  - According to press and open sources, small amounts of anthrax may still be viable deep beneath the soil's surface
- **Natural spread of pathogens that were tested on the island**
  - According to press and open sources, it is possible that rodents, birds and other wildlife have become infected with anthrax or plague
  - If true, infected animals could soon spread the bacteria to the mainland, placing humans at risk



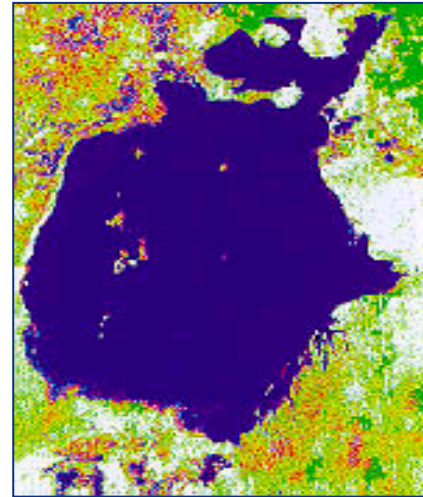
*Aral Sea no longer provides natural security for Voz Island*



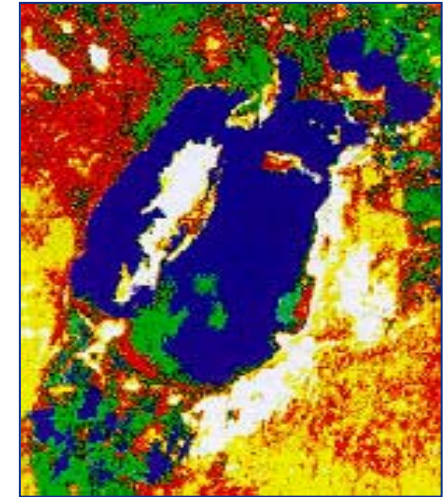
*Animals and insects are potential disease hosts and vectors*

# Aral Sea as an Ecological Disaster

- To build a Central Asian cotton bowl, Soviet state planners ordered the diversion of the Aral's river sources into concrete irrigation canals
- Once the world's fourth-largest inland body of water, it has been shrinking since the 1960s
  - Receded 70 miles in 40 years
  - Inflows 10% of 1960 inflows
  - Sea level dropped 13 m
  - Surface area decreased by 50%
  - Volume decreased by 60%
  - Salinity increased by 300%
  - Groundwater tables declined by 200%
  - 85% of the wetlands gone
  - Severe losses in biodiversity
- Island has expanded from 200km<sup>2</sup> in 1960 to 2000km<sup>2</sup>; land bridge predicted by 2010



1977



1995



November 1999



# Aral Sea as a Public Health Calamity

- Clouds of toxic dust, salts and agricultural chemicals billow across the region every year
- Rivers silted over and drinking water contaminated with high concentrations of pesticides, herbicides, fertilizers and biological contaminants
- Increasing rates of incidence of
  - Esophageal cancers (15 times higher than FSU average)
  - Typhoid, paratyphoid, viral hepatitis, dysentery; kidney, liver and immunological diseases
  - Tuberculosis (250 cases per 100,000 - highest rate in Europe and FSU)
  - Infant mortality (4 times higher than FSU average)
  - Birth defects; nervous system and mental disorders; shortened life spans
- Public health: “the worst of all developing countries” (Elhance 1997)



# Devastating Regional Economic Consequences

- Herbicides, pesticides, and salts in exposed sea bed poisoned farmlands over hundreds of thousands of square kilometers
- Once thriving fishing industry has virtually disappeared
  - 48,000 tons/year fishing industry employing 60,000 dropped to zero
- Annual economic damage estimated at \$500-600 million for agriculture and \$60-90 million for fisheries
- 270,000 refugees in first half of 1990s



*Agricultural opportunities crippled by environmental conditions*



*Former coastal fishing village and marooned fishing vessels in Kyzylorda Oblast, Kazakhstan*



# Important Unanswered Questions

- Is there any connection between the region's widespread health problems and the island?
- Has any non-endemic infectious material spread beyond the island? What animals are infected? What human populations are at risk?
- What role does the environment play in influencing disease spread in this region?
- Is it necessary to decontaminate the island? Can that be accomplished without further contaminating the island and the region?



*Boys drawing untreated water in Khiva*



*Amu Darya, 200 km above its mouth at the Aral Sea*



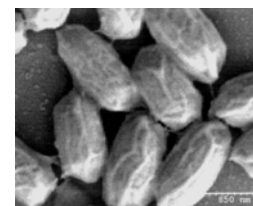
# Decontamination Without Harming Environment



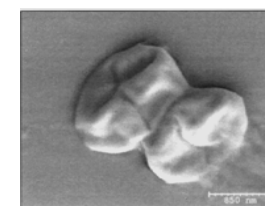
- Most decontamination formulations for CBW agents are highly toxic and/or highly corrosive
- Sandia has developed a non-toxic and non-corrosive aqueous foam for the rapid destruction of CBW agents
  - can also be deployed as a spray or fog
- Minimal health and collateral damage
  - constituents similar to hair conditioner and toothpaste
- Little logistics support required
- Small amounts of water needed



## Kill of BW Agents



As received



**Sandia Foam  
After 1 Hour**

**Complete kill of anthrax spores**



# Environmental and Animal Health Monitoring



- **Monitoring of animal populations and their environment could assess**
  - background presence of infectious (including zoonotic) disease and vectors for disease spread
  - whether disease has spread beyond the island into the region
  - effect of ecological changes over time on animal health
- **Proposal: monitoring station located on the border of Uzbekistan and Kazakhstan near the eastern edge of the Aral Sea (prevailing winds from west to east)**
  - small mammals could be kept in a sevieta – an open-air pen – and tested at regular intervals for antibodies or signs of diseases
  - meteorological monitoring could include the collection of air, soil, water, rainfall, solar flux and other environmental data
- **Alternative: separate sevietas in Uzbekistan and Kazakhstan – perhaps closer to larger population centers – and sharing of data through an Internet web site**



*Environmental Monitoring Station*



*The Aral Sea (1985)*

# Syndromic and Epidemiological Monitoring

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- **Objective: establish a system that can identify a possible human anthrax or plague case as early as possible, as well as strengthen the practice of public health**
- **Sandia has developed an internet-based system that tracks human syndromes that are associated with dangerous, infectious diseases**
  - **Links patient-care and regional public-health communities**
  - **Takes advantage of modern communication and data management systems**
  - **Easy and inexpensive to operate**
  - **Data automatically displayed spatially and temporally in near real time**
    - ◆ **Helps health care professionals recognize novel diseases sooner**
    - ◆ **Triggers earlier regional epidemiological investigations**
- **Sandia's Rapid Syndromic Validation Project (RSVP) has been operational in New Mexico since December 2000**

# RAPID SYNDROME VALIDATION PROJECT

ZIP CODE (home)  (click to select)

ZIP CODE (work)  (click to select)

## OCCUPATION

- ☐ CHILD CARE/SCHOOL
- ☐ HEALTHCARE PROFESSIONAL
- ☐ FOOD HANDLER
- ☐ AGRICULTURE
- ☐ MILITARY/PUBLIC SAFETY
- ☐ OTHER

GENDER ☒ M ☐ F

AGE ☐ <18 ☒ 30 ☐ 45 ☐ 60 ☐ 75 ☐ >75

CONTACT WITH PERSON  
WITH SIMILAR ILLNESS ☒ Y ☐ N

RECENT TRAVEL ☒ Y ☐ N

☐ INTERNATIONAL ☐ U.S.

## Select A Screen Based On Syndrome

Influenza-like Illness

Fever with Skin Findings (e.g., rash)

Fever and Altered Mental Status  
(Potentially Infectious)

Acute Bloody Diarrhea

Hepatitis

Contact the NM  
Department of Health for information  
or to report this case

**CANCEL**



# INFLUENZA-LIKE ILLNESS

## HISTORY/SYMPTOMS

Cough ☒ Y ☐ N ☒ PRODUCTIVE ☐ NON-PRODUCTIVE ☐ HEMOPTYSIS

URI Symptoms ☒ Y ☐ N ☒ SORE-THROAT ☐ NASAL CONGESTION

Conjunctivitis ☒ Y ☐ N

GI Symptoms ☒ Y ☐ N ☒ ABDOMINAL PAIN ☒ NAUSEA/VOMITING ☐ DIARRHEA

Headache ☒ Y ☐ N ☐ MILD ☒ MODERATE ☐ SEVERE

Myalgia ☒ Y ☐ N ☐ MILD ☒ MODERATE ☐ SEVERE

## SIGNS

Temperature ☐ <36 ☐ 37 ☒ 39 ☐ 40 ☐ 41 ☐ >41 Increased Respiratory Rate ☒ Y ☐ N

O<sub>2</sub> Sat. ☐ <75 ☐ 75 ☐ 80 ☐ 85 ☐ 90 ☒ 95 ☐ 100

Abnormal Lung Sounds ☒ Y ☐ N ☒ UNILATERAL ☐ BILATERAL ☐ WHEEZING ☐ OTHER

Rash ☒ Y ☐ N Stiff Neck ☒ Y ☐ N ☐ MILD ☒ MODERATE ☐ SEVERE

## LABS

WBC ☐ <2000 ☐ 5000 ☐ 10,000 ☐ 15,000 ☒ 20,000 ☐ >20,000 Platelet ☐ <50 ☐ 50 ☐ 100 ☐ 150 ☒ >150

Chest X-Ray ☒ NORMAL ☐ ABNORMAL ☐ FOCAL INFILTRATE ☐ DIFFUSE INFILTRATE ☐ EFFUSION ☐ WIDE MEDIASTINUM

Physician Comment

Auto Report

Done

CANCEL



# FEVER WITH SKIN FINDINGS

## HISTORY/SYMPTOMS

URI Symptoms ☒ Y ☐ N ☒ SORE-THROAT ☒ NASAL CONGESTION

Conjunctivitis ☒ Y ☐ N

GI Symptoms ☒ Y ☐ N ☒ ABDOMINAL PAIN ☒ NAUSEA/VOMITING ☒ DIARRHEA

Headache ☒ Y ☐ N ☐ MILD ☒ MODERATE ☐ SEVERE

Myalgia ☒ Y ☐ N ☐ MILD ☒ MODERATE ☐ SEVERE

Arthralgia/Arthritis ☒ Y ☐ N Animal/Insect Bite ☒ Y ☐ N

## SIGNS

Temperature ☐ <36 ☒ 37 ☐ 39 ☐ 40 ☒ 41 ☐ >41

Duration of Fever Before Rash ☐ 0 ☐ 1 ☒ 2 ☐ 3 ☐ >3

Hypotension ☒ Y ☐ N Adenopathy ☒ Y ☐ N Hepato/Splenomegaly ☒ Y ☐ N

Rash ☒ Y ☐ N Stiff Neck ☒ Y ☐ N ☐ MILD ☒ MODERATE ☐ SEVERE

## LABS

WBC ☐ <2000 ☐ 5000 ☒ 10,000 ☐ 15,000 ☐ 20,000 ☒ >20,000 Platelet ☐ <50 ☐ 50 ☐ 100 ☐ 150 ☒ >150

Transaminase ☐ NORMAL ☒ 2-3X ☐ ← ELEVATED → ☐ >3X Creatinine ☒ NORMAL ☐ ABNORMAL

Physician Comment

Auto Report

Done

CANCEL

# FINDINGS OVERVIEW

## SPATIAL DISTRIBUTION



## ADVISORY MESSAGE

**Alert!**

## SYNDROME SUMMARY

**SUMMARY**

**INFLUENZA-LIKE ILLNESS**

**HISTORY/SYMPTOMS**

Cough: ☒ **Y** ☐ **N** ☒ **PRODUCTIVE** ☐ **NON-PRODUCTIVE** ☐ **HEMOPTYSIS**

URI Symptoms: ☒ **Y** ☐ **N** ☒ **SORE THROAT** ☐ **NASAL CONGESTION**

Conjunctivitis: ☒ **Y** ☐ **N**

GI Symptoms: ☒ **Y** ☐ **N** ☐ **ABDOMINAL PAIN** ☐ **NAUSEA/VOMITING** ☐ **DIARRHEA**

Headache: ☒ **Y** ☐ **N** ☐ **MILD** ☒ **MODERATE** ☐ **SEVERE**

Myalgia: ☒ **Y** ☐ **N** ☐ **MILD** ☒ **MODERATE** ☐ **SEVERE**

**SIGNS**

Temperature: ☒ **38.0** ☐ **37.5** ☐ **37.0** ☐ **36.5** ☐ **36.0** ☐ **35.5** ☐ **35.0** ☐ **34.5** ☐ **34.0** ☐ **33.5** ☐ **33.0** ☐ **32.5** ☐ **32.0** ☐ **31.5** ☐ **31.0** ☐ **30.5** ☐ **30.0** ☐ **29.5** ☐ **29.0** ☐ **28.5** ☐ **28.0** ☐ **27.5** ☐ **27.0** ☐ **26.5** ☐ **26.0** ☐ **25.5** ☐ **25.0** ☐ **24.5** ☐ **24.0** ☐ **23.5** ☐ **23.0** ☐ **22.5** ☐ **22.0** ☐ **21.5** ☐ **21.0** ☐ **20.5** ☐ **20.0** ☐ **19.5** ☐ **19.0** ☐ **18.5** ☐ **18.0** ☐ **17.5** ☐ **17.0** ☐ **16.5** ☐ **16.0** ☐ **15.5** ☐ **15.0** ☐ **14.5** ☐ **14.0** ☐ **13.5** ☐ **13.0** ☐ **12.5** ☐ **12.0** ☐ **11.5** ☐ **11.0** ☐ **10.5** ☐ **10.0** ☐ **9.5** ☐ **9.0** ☐ **8.5** ☐ **8.0** ☐ **7.5** ☐ **7.0** ☐ **6.5** ☐ **6.0** ☐ **5.5** ☐ **5.0** ☐ **4.5** ☐ **4.0** ☐ **3.5** ☐ **3.0** ☐ **2.5** ☐ **2.0** ☐ **1.5** ☐ **1.0** ☐ **0.5** ☐ **0.0** ☐ **-0.5** ☐ **-1.0** ☐ **-1.5** ☐ **-2.0** ☐ **-2.5** ☐ **-3.0** ☐ **-3.5** ☐ **-4.0** ☐ **-4.5** ☐ **-5.0** ☐ **-5.5** ☐ **-6.0** ☐ **-6.5** ☐ **-7.0** ☐ 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**-207.0** ☐ **-207.5** ☐ **-208.0** ☐ **-208.5** ☐ **-209.0** ☐ **-209.5** ☐ **-210.0** ☐ **-210.5** ☐ **-211.0** ☐ **-211.5** ☐ **-212.0** ☐ **-212.5** ☐ **-213.0** ☐ **-213.5** ☐ **-214.0** ☐ **-214.5** ☐ **-215.0** ☐ **-215.5** ☐ **-216.0** ☐ **-216.5** ☐ **-217.0** ☐ **-217.5** ☐ **-218.0** ☐ **-218.5** ☐ **-219.0** ☐ **-219.5** ☐ **-220.0** ☐ **-220.5** ☐ **-221.0** ☐ **-221.5** ☐ **-222.0** ☐ **-222.5** ☐ **-223.0** ☐ **-223.5** ☐ **-224.0** ☐ **-224.5** ☐ **-225.0** ☐ **-225.5** ☐ **-226.0** ☐ **-226.5** ☐ **-227.0** ☐ **-227.5** ☐ **-228.0** ☐ **-228.5** ☐ **-229.0** ☐ **-229.5** ☐ **-230.0** ☐ **-230.5** ☐ **-231.0** ☐ **-231.5** ☐ **-232.0** ☐ **-232.5** ☐ **-233.0** ☐ **-233.5** ☐ **-234.0** ☐ **-234.5** ☐ **-235.0** ☐ **-235.5** ☐ **-236.0** ☐ **-236.5** ☐ **-237.0** ☐ **-237.5** ☐ **-238.0** ☐ **-238.5** ☐ **-239.0** ☐ **-239.5** ☐ **-240.0** ☐ **-240.5** ☐ **-241.0** ☐ **-241.5** ☐ **-242.0** ☐ **-242.5** ☐ **-243.0** ☐ **-243.5** ☐ **-244.0** ☐ **-244.5** ☐ **-245.0** ☐ **-245.5** ☐ **-246.0** ☐ **-246.5** ☐ **-247.0** ☐ **-247.5** ☐ **-248.0** ☐ **-248.5** ☐ **-249.0** ☐ **-249.5** ☐ **-250.0** ☐ **-250.5** ☐ **-251.0** ☐ **-251.5** ☐ **-252.0** ☐ **-252.5** ☐ **-253.0** ☐ **-253.5** ☐ **-254.0** ☐ **-254.5** ☐ **-255.0** ☐ **-255.5** ☐ **-256.0** ☐ **-256.5** ☐ **-257.0** ☐ **-257.5** ☐ **-258.0** ☐ **-258.5** ☐ **-259.0** ☐ **-259.5** ☐ **-260.0** ☐ **-260.5** ☐ **-261.0** ☐ **-261.5** ☐ **-262.0** ☐ **-262.5** ☐ **-263.0** ☐ **-263.5** ☐ **-264.0** ☐ **-264.5** ☐ **-265.0** ☐ **-265.5** ☐ **-266.0** ☐ **-266.5** ☐ **-267.0** ☐ **-267.5** ☐ **-268.0** ☐ **-268.5** ☐ **-269.0** ☐ **-269.5** ☐ **-270.0** ☐ **-270.5** ☐ **-271.0** ☐ **-271.5** ☐ **-272.0** ☐ **-272.5** ☐ **-273.0** ☐ **-273.5** ☐ **-274.0** ☐ **-274.5** ☐ **-275.0** ☐ **-275.5** ☐ **-276.0** ☐ **-276.5** ☐ **-277.0** ☐ **-277.5** ☐ **-278.0** ☐ **-278.5** ☐ **-279.0** ☐ **-279.5** ☐ **-280.0** ☐ **-280.5** ☐ **-281.0** ☐ **-281.5** ☐ **-282.0** ☐ **-282.5** ☐ **-283.0** ☐ **-283.5** ☐ **-284.0** ☐ **-284.5** ☐ **-285.0** ☐ **-285.5** ☐ **-286.0** ☐ **-286.5** ☐ **-287.0** ☐ **-287.5** ☐ **-288.0** ☐ **-288.5** ☐ **-289.0** ☐ **-289.5** ☐ **-290.0** ☐ **-290.5** ☐ **-291.0** ☐ **-291.5** ☐ **-292.0** ☐ **-292.5** ☐ **-293.0** ☐ **-293.5** ☐ **-294.0** ☐ **-294.5** ☐ **-295.0** ☐ **-295.5** ☐ **-296.0** ☐ **-296.5** ☐ **-297.0** ☐ **-297.5** ☐ **-298.0** ☐ **-298.5** ☐ **-299.0** ☐ **-299.5** ☐ **-300.0** ☐ **-300.5** ☐ **-301.0** ☐ **-301.5** ☐ **-302.0** ☐ **-302.5** ☐ **-303.0** ☐ **-303.5** ☐ **-304.0** ☐ **-304.5** ☐ **-305.0** ☐ **-305.5** ☐ **-306.0** ☐ **-306.5** ☐ **-307.0** ☐ **-307.5** ☐ **-308.0** ☐ **-308.5** ☐ **-309.0** ☐ **-309.5** ☐ **-310.0**

# Syndromic and Epidemiological Monitoring

- **Proposal: establish RSVP sites in hospitals/public-health centers near the Aral Sea and in major metropolitan areas of Kazakhstan and Uzbekistan**
  - Use RSVP to link these hospitals with the anti-plague institutes and epidemiological expertise in the region
  - KZ and UZ health care workers and epidemiologists could jointly monitor for syndromes associated with plague and anthrax, as well as for syndromes common to other dangerous, infectious diseases



- **Environmental and public health threats in the Aral Sea region of Central Asia are daunting but not insurmountable**
- **Need for a multinational, multidisciplinary scientific set of solutions**
  - **Decontamination of Vozrozhdeniye Island**
  - **Cooperative environmental and animal health monitoring**
  - **Cooperative syndromic and epidemiological monitoring**